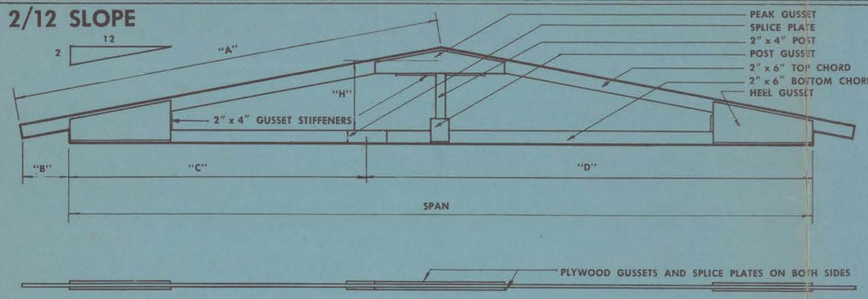
KING-POST NAIL-GLUED ROOF TRUSSES USING 2″ x 6″ MEMBERS—

2′ ON CENTER, 25′-0″ TO 32′-8″ SPANS
2/12 SLOPE 3/12 SLOPE 4/12 SLOPE

2/12 SLOPE



DESIGN AND PERFORMANCE DATA ON 2″ x 6″ KING-POST TRUSSES

DESIGN DATA

Spans of 25′-0″ to 32′-8″
Slope of 2/12

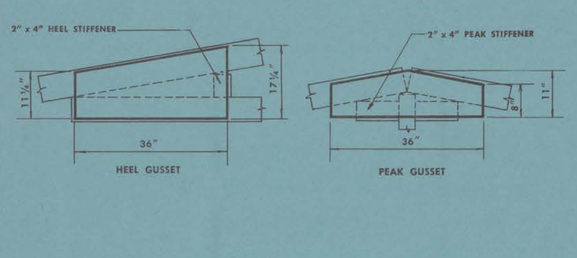
Recommended Design Load *(pounds per square foot of horizontal projection)*	40 psf
Roof *(dead load + live load)*	35 psf
Ceiling *(dead load)*	5 psf

PERFORMANCE DATA ON 32′-8″ TEST

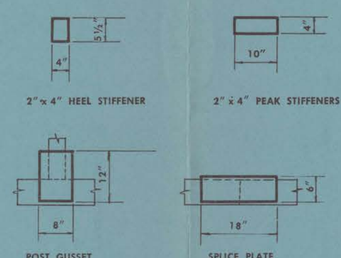
Maximum allowable deflection *(1/360 span)*	1.09″
Deflections at design load	
quarter points	0.40″
mid-span	0.39″
Test load at failure	109 psf

SPAN			25′			26′			27′			28′			29′			30′			31′			32′		
			0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″
TOP CHORDS	Length	"A"	16′-0″									18′-0″												20′-0″		
	Overhang	"B"	39½″	37½″	35½″	33½″	31½″	29½″	27½″	25½″	47½″	45½″	43½″	41½″	39½″	37½″	35½″	33½″	31½″	29½″	27½″	25½″	23½″	45½″	43½″	41½″
BOTTOM CHORDS	Member	"C"	10′-0″									12′-0″									14′-0″					
	Cut Member	"D"	15′-0″	15′-4″	15′-8″	16′-0″	16′-4″	14′-8″	15′-0″	15′-4″	15′-8″	16′-0″	16′-4″	16′-8″	17′-0″	17′-4″	17′-8″	18′-0″	18′-4″	16′-8″	17′-0″	17′-4″	17′-8″	18′-0″	18′-4″	18′-8″
POST	Length		24⅝″	25″	25⅜″	25⅝″	26″	26⅜″	26⅝″	27″	27⅜″	27⅝″	28″	28⅜″	28⅝″	29″	29⅜″	29⅝″	30″	30⅜″	30⅝″	31″	31⅜″	31⅝″	32″	32⅜″
HEIGHT (Inside Dimension)		"H"	25″	25⅜″	25⅝″	26″	26⅜″	26⅝″	27″	27⅜″	27⅝″	28″	28⅜″	28⅝″	29″	29⅜″	29⅝″	30″	30⅜″	30⅝″	31″	31⅜″	31⅝″	32″	32⅜″	32⅝″

PLYWOOD GUSSETS Spans of 25′-0″ to 28′-8″
(For thicknesses, see notes below on nail-gluing.)

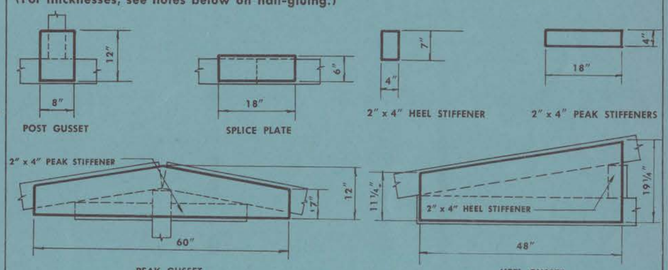


STIFFENERS

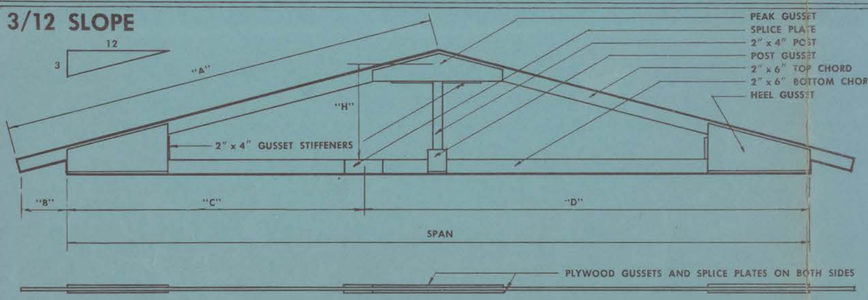


PLYWOOD GUSSETS Spans of 29′-0″ to 32′-8″;
(For thicknesses, see notes below on nail-gluing.)

STIFFENERS



3/12 SLOPE



DESIGN AND PERFORMANCE DATA ON 2″ x 6″ KING-POST TRUSSES

DESIGN DATA

Spans of 25′-0″ to 32′-8″
Slope of 3/12

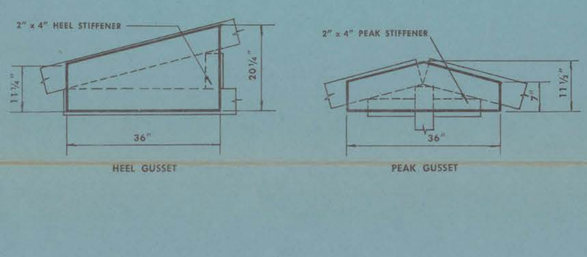
Recommended Design Load *(pounds per square foot of horizontal projection)*	50 psf
Roof *(dead load + live load)*	45 psf
Ceiling *(dead load)*	5 psf

PERFORMANCE DATA ON 32′-8″ TEST

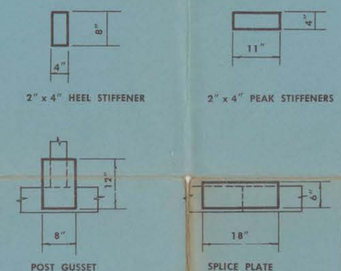
Maximum allowable deflection *(1/360 span)*	1.09″
Deflections at design load	
quarter points	0.43″
mid-span	0.24″
Test load at failure	127 psf

SPAN			25′			26′			27′			28′			29′			30′			31′			32′		
			0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″
TOP CHORDS	Length	"A"	16′-0″									18′-0″												20′-0″		
	Overhang	"B"	36¼″	34¼″	32¼″	30¼″	28¼″	26¼″	24¼″	22¼″	44¼″	42¼″	40¼″	38¼″	36¼″	34¼″	32¼″	30¼″	28¼″	26¼″	24¼″	22¼″	20¼″	42¼″	40¼″	38¼″
BOTTOM CHORDS	Member	"C"	10′-0″									12′-0″									14′-0″					
	Cut Member	"D"	15′-0″	15′-4″	15′-8″	16′-0″	16′-4″	14′-8″	15′-0″	15′-4″	15′-8″	16′-0″	16′-4″	16′-8″	17′-0″	17′-4″	17′-8″	18′-0″	18′-4″	16′-8″	17′-0″	17′-4″	17′-8″	18′-0″	18′-4″	18′-8″
POST	Length		37″	37½″	38″	38½″	39″	39½″	40″	40½″	41″	41½″	42″	42½″	43″	43½″	44″	44½″	45″	45½″	46″	46½″	47″	47½″	48″	48½″
HEIGHT (Inside Dimension)		"H"	37½″	38″	38½″	39″	39½″	40″	40½″	41″	41½″	42″	42½″	43″	43½″	44″	44½″	45″	45½″	46″	46½″	47″	47½″	48″	48½″	49″

PLYWOOD GUSSETS Spans of 25′-0″ to 28′-8″
(For thicknesses, see notes below on nail-gluing.)

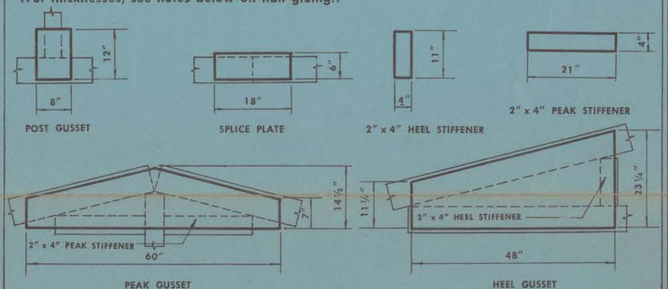


STIFFENERS

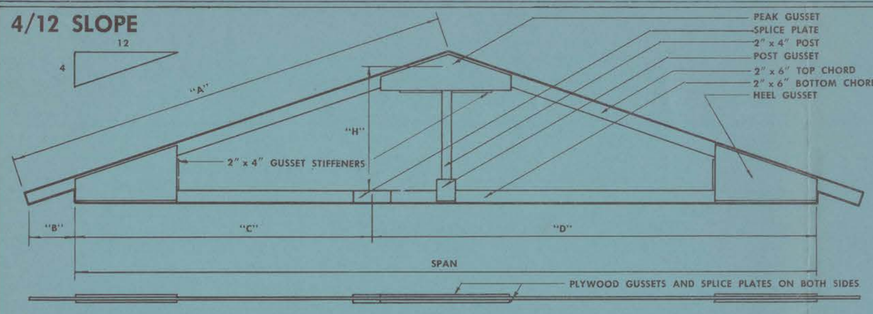


PLYWOOD GUSSETS Spans of 29′-0″ to 32′-8″
(For thicknesses, see notes below on nail-gluing.)

STIFFENERS



4/12 SLOPE



DESIGN AND PERFORMANCE DATA ON 2″ x 6″ KING-POST TRUSSES

DESIGN DATA

Spans of 25′-0″ to 32′-8″
Slope of 4/12

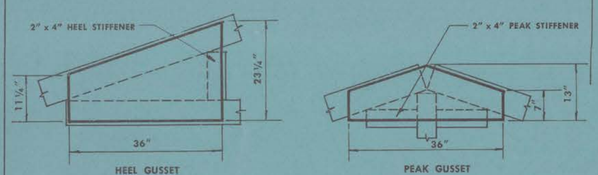
Recommended Design Load *(pounds per square foot of horizontal projection)*	60 psf
Roof *(dead load + live load)*	35 psf
Ceiling *(dead load)*	5 psf
Attic storage *(live load)*	20 psf

PERFORMANCE DATA ON 32′-8″ TEST

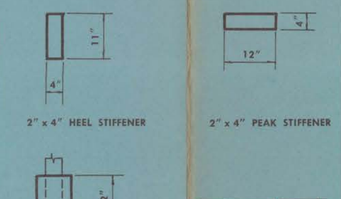
Maximum allowable deflection *(1/360 span)*	1.09″
Deflections at design load	
quarter points	0.33″
mid-span	0.18″
Test load at failure	254 psf

SPAN			25′			26′			27′			28′			29′			30′			31′			32′		
			0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″	0″	4″	8″
TOP CHORDS	Length	"A"	16′-0″									18′-0″												20′-0″		
	Overhang	"B"	32⅛″	30⅛″	28⅛″	26⅛″	24⅛″	22⅛″	20⅛″	18⅛″	38⅞″	36⅞″	34⅞″	32⅞″	30⅞″	28⅞″	26⅞″	24⅞″	22⅞″	20⅞″	18¾″	38¾″	36¾″	34¾″	32¾″	30¾″
BOTTOM CHORDS	Member	"C"	10′-0″									12′-0″									14′-0″					
	Cut Member	"D"	15′-0″	15′-4″	15′-8″	16′-0″	16′-4″	14′-8″	15′-0″	15′-4″	15′-8″	16′-0″	16′-4″	16′-8″	17′-0″	17′-4″	17′-8″	18′-0″	18′-4″	16′-8″	17′-0″	17′-4″	17′-8″	18′-0″	18′-4″	18′-8″
POST	Length		49⅜″	50″	50⅜″	51⅜″	52″	52⅜″	53⅜″	54″	54⅜″	55⅜″	56″	56⅜″	57⅜″	58″	58⅜″	59⅜″	60″	60⅜″	61⅜″	62″	62⅜″	63⅜″	64″	64⅜″
HEIGHT (Inside Dimension)		"H"	50″	50⅜″	51⅜″	52″	52⅜″	53⅜″	54″	54⅜″	55⅜″	56″	56⅜″	57⅜″	58″	58⅜″	59⅜″	60″	60⅜″	61⅜″	62″	62⅜″	63⅜″	64″	64⅜″	65⅜″

PLYWOOD GUSSETS Spans of 25′-0″ to 28′-8″
(For thicknesses, see notes below on nail-gluing.)

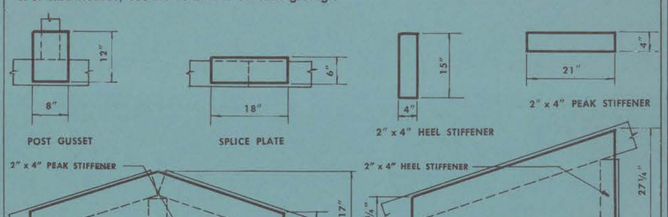


STIFFENERS



PLYWOOD GUSSETS Spans of 29′-0″ to 32′-8″
(For thicknesses, see notes below on nail-gluing.)

STIFFENERS



STRUCTURAL DESIGN DATA FOR KING-POST TRUSSES

The graphical methods of analysis (funicular polygon) generally used for trusses designed with pin-connected joints should not be used for analyzing trusses with nail-glued plywood gussets because the results will be inaccurate. Funicular polygons show only tension or compression stresses in a structure, and in no way indicate the combined stresses due to secondary bending. Analytical methods are also unreliable.

The gusset plates used in nail-glued trusses form rigid connections between the structural members and introduce secondary bending in the chord members. The large peak and heel gussets cause the top chords of the king-post trusses to act as a beam with partially restrained ends; therefore, distribution of stresses in the top chords is considerably different and less than the stresses for a pin-connected member. The bottom chord is a tension member. It acts as a two-span continuous beam partially restrained at the center and its ends, and it resists a moment which is transferred through the heel gusset from the top chords. The center post is in pure tension.

The deflection pattern of the king-post nail-glued truss under design load is entirely different from that for a pin-connected truss of the same geometry. The pin-connected truss will show maximum deflection at the mid-span with the lower-chord deflection pattern in the shape of a "V". The lower-chord deflection of the nail-glued truss takes the form of a very flat "W", the maximum deflection being just inside the heel gussets near the third points of the lower chord.

The king-post truss designs are based on test results 1) from full-size trusses tested individually in a hydraulic testing machine, and 2) on pairs of trusses set up 24″ on center, sheathed, bridged for lateral support, and loaded with concrete block as live load on the roof surface and bottom chord. Three types of tests were made to determine the performance of a design: load-and-recovery, long-duration load, and load-to-destruction tests.

In the load-and-recovery test, (a performance test to observe the behavior of a truss under loads that exceed design loads), a load of 100 lbs. per sq. ft., equaling two and one-half times the predicted design load, was applied to the truss. Deflection readings were taken as the load was applied in increments of 20 lbs. per sq. ft. Residual deflection was measured after the entire load was removed. This test determined the maximum load the truss can carry for acceptable performance. The nail-glued king-post trusses are exceptionally stiff and will sustain loads of at least 100 lbs. per sq. ft. without exceeding the allowable deflection of 1/360 of the span.

The long-duration test was an accelerated time test lasting 120 days with a design load applied to the truss. The test was designed to expose any deformation or creep that might occur due to heavy loads imposed for a long period. Stiffness is a general characteristic of nail-glued trusses, and they show very little creep under long-duration tests.

The destruction test determined the maximum load capacity of the truss, behavior when greatly over-stressed, and critical points of the design. The king-post nail-glued trusses will carry from 3½ to 5 times the predicted design load before failure. In every case observed, failure occurred in either the top or bottom chord member. Failure never occurred in a plywood gusset or in the glue bond.

MATERIALS AND NAIL-GLUING FABRICATION

The quality of material and workmanship is important to the ultimate strength of the truss. Nail-glued roof trusses do not require precise cutting and fitting of members, but **the builder must use good judgment in the selection of materials and must follow the simple instructions for gluing, nailing, curing, and handling the trusses as set forth in the Small Homes Council instruction sheet, NAIL-GLUING OF ROOF TRUSSES AND FRAMES.**

- Use plyscored (unsanded) grade plywood, either 5/16″ or ½″ thick. When 5/16″ plywood is used, 1″ x 4″ solid wood splice plates and 2″ x 4″ gusset stiffeners are required on the peak and heel gussets. If ½″ plywood is used, the splice plates can also be ½″ plywood and gusset stiffeners are not required. When laying out the pattern to cut gussets from 4 x 8 sheet of plywood, **be sure that the surface grain of the plywood gussets runs parallel to the bottom chord.**
- For structural members, use lumber of 1450 p.s.i. stress grade, No. 1 Douglas Fir, or the equivalent, having a moisture content between 12 and 18 percent.
- Mix powdered, Grade "A", casein glue in strict accordance with manufacturer's instructions.
- Use 4-d nails or 1¼″ staples for nailing plywood gussets and splice plates. 6-d nails for 1″ solid wood splice plates. Space nails 4 inches apart in two rows for 2″ x 4″ members and in three rows for 2″ x 6″ members. Nails should be ¾-inch from edges of the plywood.
- Protect truss against rain and temperatures below 50°F during fabrication and curing. After truss is nailed, it should be stacked and not handled again for a 24-hour period.

UNIVERSITY OF ILLINOIS SMALL HOMES COUNCIL URBANA, ILLINOIS

KING-POST NAIL-GLUED ROOF TRUSSES USING 2″ x 6″ MEMBERS — 2/12, 3/12, 4/12 SLOPES

2′ on Center, 25′-0″ to 32′-8″ Spans

JAMES T. LENDRUM, A.I.A.
HOWARD E. MC CALL
University of Illinois

BYRON M. RADCLIFFE
STANLEY K. SUDDARTH
Purdue University

PRICE: 25 CENTS

A.I.A. 19-B-3(h)